THE CERAMBYCOID SEMI-AQUATIC COLEOPTERA OF THE NEVADA AREA

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The following pages constitute the fifth in a series dealing with the aquatic and semi-aquatic Coleoptera of Nevada and its immediate environs[1]. The group to be here considered is a small, relatively little known segment of a large, familiar family—the most pressing need at the present is for more penetrating investigation of the life-histories of these semi-aquatic aberrants of the family, and it is hoped that this resumé of the species known or expected for the Nevada area will call some small attention to the problem.

CERAMBYCOIDEA

Chrysomelidae

A small number of species of this large, herbivorous family are intimately associated with aquatic plants, either boring into stems and roots below water, or feeding on exposed or submerged leaves. Host plants are such common and wide-spread species as pickerel weed *(Pontedaria cordata)*, pondweed *(Potamogeton* spp.). pondlily *(Nymphaea* spp.—*Nuphar* spp.), bur-reed *(Sparganium* spp.), arrowhead *(Sagittaria* spp.), duckweed *(Lemna* spp.), bulrushes *(Scirpus* spp.), cat-tails *(Typha* spp.) and various sedges.

The larvae obtain oxygen by digging into the plant tissues underwater and freeing intercellular oxygen. When ready to pupate, they spin tough, water-and-air-tight cocoons, attached to the roots of underwater stems, and obtain needed oxygen by special structures which tap the plant surfaces to which the cocoons are attached. Adults of those species laying their eggs underwater are heavily provided with hydrofuge hairs, allowing the insects to take an adequate supply of air for their work beneath the surface of the water.

Keys to the semi-aquatic genera of Chrysomelidae occuring in the Nevada area.

1(A)—1950. The Dryopoidea known or expected to occur in the Nevada area (Coleoptera). Wasmann Jour. Biol. 8(1):97-111.

(B)—1950 (1949). Hydradephagous Coleoptera of the Nevada area, exclusive of the Dytiscidae. Bull. S. Calif. Acad. Sci. 48(3):129-140.

(C)—1950. The Staphylinoid and Dascilloid aquatic Coleoptera of the Nevada area. Great Basin Nat. 10(1-4):66-70.

(D)—1951. Nevada Dytiscidae (Coleoptera). Amer. Midl. Nat. 45(2):392-406.

(MacGillivray 1903)

ADULTS

1. Prothorax with a distinct thin lateral margin (Galerucinae) ..... (Galerucella)
——Prothorax without a thin lateral margin (Donaciinae) 2
2. Tarsi dilated, spongy beneath; fifth tarsal segment subequal to, or shorter than, the second and third segments together ..... DONACIA
——Tarsi not dilated—narrow, glabrous; the fifth tarsal segment distinctly longer than the second and third together ..... (Haemonia)

LARVAE

1. Dorsum of eighth abdominal segment without a pair of long spines; abdominal prolegs present (Galerucinae) ..... (Galerucella)
——Dorsum of eighth abdominal segment with a pair of pointed spines; abdominal prolegs wanting (Donaciinae) 2
2. Sixth and seventh abdominal tergites each with a double row of setae of the same length as those found on the other tergites; the supraspiracular setae always present .. DONACIA
——Sixth and seventh abdominal tergites each with a double row of setae, most of which are twice as long as those on the other tergites; the supraspiracular setae wanting .... (Haemonia)

Galerucinae

(*Galerucella* Crotch, 1873)

G. nymphaeae (Linné) 1758 is the only aquatic member known to me, breeding on *Nymphaea advena* and is holarctic in distribution. The larvae feed on the leaf epidermis.

Donaciinae

DONACIA Fabricius, 1775

Our species may be distinguished by Schaeffer's 1925 key; with modifications by Mead (1938):

1. Elytral sutural margin sinuate near apex; ocular orbits absent; first ventral segment of abdomen generally about as long as the three succeeding segments (Subgenus *Plateumaris)* 2
——Elytral sutural margin straight to apex; ocular orbits distinct; first ventral abdominal segment about as long or slightly longer than the four succeeding segments (Subgenus *Donacia)* 7
2. Hindfemora uniformly metallic with a moderate-to-large tooth ..... *(emarginata* Kirby, 1837)
——Hindfemora bicolored or entirely red, tooth variable in size 3
3. Hindfemoral tooth moderate-to-large in size ..... *germari*
——Hindfemoral tooth very small or absent 4
4. Prosternal sidepieces finely rugose, at least in anterior half, posteriorly more-or-less distinctly finely strigate-rugose .... *pusilla pyritosa*

——Prosternal sidepieces relatively coarsely strigate, at least posteriorly, anteriorly often strigate-rugose but then never finely so 5

5. Elytra lacking transverse, coarse rugae, intervals vermiculate-rugose (prothorax finely rugulose with moderately large punctures) ..... *(vermiculata* Schaeffer, 1925)

——Elytra with more-or-less distinct coarse rugae, intervals punctate, not vermiculate-rugose 6

6. Prothorax appearing longer than usual, very finely rugose or strigate-rugose, with or without moderately large punctures; lateral tubercle rather elongate; antennal segments 4-11 elongate ..... *(longicollis* Schaeffer, 1925)

——Prothorax as usual, rather short and less finely strigate-rugose, with large-to-small punctures; lateral tubercles not elongate; antennal segments shorter and nearly as in *pusilla* (= rather stout, segments 2-3 small, equal or subequal, terminal segments stouter) ..... *(dubia* Schaeffer, 1925)

7. Terminal abdominal segment truncate with a more-or-less deep impression at middle of apex (males) 8

——Terminal abdominal segment triangular and generally narrowly rounded at apex, without median depression (females).. 18

8. Hindtibiae at apex internally produced into a short, but distinct tooth (posterior femora with a large, somewhat compressed triangular tooth and a more-or-less distinct denticle in front of the tooth) ..... *(piscatrix* Lacordaire, 1845)

——Hindtibiae not produced apically into a tooth 9

9. Hindfemora long, extending to or beyond elytral apices 10

——Hindfemora decidedly shorter, never extending to elytral apices 12

10. Hindfemora not extending beyond elytral apices; posterior tooth rather long, acute, behind which is a serrate oblique ridge, the latter often reduced to a few denticles in small specimens; outer apical elytral angles obliterated, broadly rounded;anterior transverse impression of prothorax generally distinct ..... *(proxima)* .. 11

——Hindfemora extending well beyond elytral apices, armature as in *proxima;* outer apical angles of elytra distinct, though more-or-less narrowly rounded; anterior transverse impression of prothorax usually absent .... *(cincticornis* Newman, 1838)

11. Dorsum metallic blue, strial punctuation moderately coarse, punctures often greenish, median basal triangulate excavation usually indistinct ..... *(proxima proxima* Kirby, 1837)

——Dorsum metallic green and/or cupreous, strial punctuation coarse, basal triangulate excavation deep ..... *(proxima californica* Le Conte, 1861)

12. Hindfemora bearing two teeth, the inner occasionally very small, tubercle-like ..... *(pubescens* Le Conte, 1867)

——Hindfemora with only one tooth 13

13. Prothorax finely and densely punctate and pubescent; elytra without fine elevated sutural beed .....*hirticollis*

——Prothorax not pubescent, punctuation variable; elytra with distinct, elevated sutural beed 14

14. Head deeply narrowed behind; eyes small, not prominent; prothorax with impressed median line and moderately distinct lateral tubercles; elytra without coarse, transverse rugae, intervals relatively finely rugose from base-to-apex; last dorsal abdominal segment of both sexes generally

emarginate at middle of apex ..... *(distincta)* .. 15

——Head slightly narrowed behind; eyes moderately large, prominent; prothorax with or without impressed median line and lateral tubercles; elytra with more-or-less distinct coarse, transverse rugae, intervals often densely rugose from base-to-apex or smooth and feeble rugose in about basal half but more densely rugose towards apex; last dorsal abdominal segment of both sexes not or rarely feebly emarginate 16

15. Hindfemur clavate with a moderately large and acute tooth, apical third of elytra depressed ..... *(distincta distincta* Le Conte, 1850)

——Hindfemur less clavate with a very small obscure tooth, apical third of elytra curved ventrad ..... *(distincta occidentalis* Mead, 1938)

16. Form more convex and subparallel; elytra, viewed laterad, arcuately declivous towards apex; prothorax scarcely converging behind, lateral tubercles more-or-less distinct and median line always present; antennae generally stouter ..... *(tuberculifrons* Schaeffer, 1919)

——Form elongate; elytra subtriangular and, viewed laterad, flattened toward apen; prothoracic sides distinctly converging behind, lateral tubercles indistinct; median line rarely present; antennae more slender ..... *(subtilis)* .. 17

17. Abundant coarse transverse rugae on elytra; antennae slender; hindfemora clavate ..... *(subtilis subtilis* Kunze, 1818)

——Fine and dense strigate-rugous sculpturing on elytra, coarse transverse rugae sparse; antennae stouter; hindfemora less clavate ..... *(subtilis magistrigata* Mead, 1938)

18. Hindfemora unarmed below 19

——Hindfemora armed below with one or more teeth or tubercles 20

19. Elytra pubescent ..... *(pubescens* Le Conte, 1867)

——Elytra glabrous ..... *hirticollis*

20. Hindfemora armed below with one tooth and behind this an oblique serrate ridge (seen more plainly from an internal view), which latter is often reduced to one or more denticles 21

——Hindfemora below with one tooth but without an oblique ridge of denticles behind 23

21. Outer elytral apical angle distinct, but feebly rounded; anterior transverse impression of prothorax usually absent ..... *(cincticornis* Newman, 1838)

——Outer elytral apical angle not distinct, broadly rounded; anterior transverse impression of prothorax usually distinct ..... *(proxima)* .. 22

22. Dorsum metallic blue, strial punctuation moderately coarse, punctures often greenish, median basal triangulate excavation usually indistinct ..... *(proxima proxima* Kirby, 1837)

——Dorsum metallic green and/or cupreous, strial punctuation coarse, basal triangulate excavation deep ..... *(proxima californica* Le Conte, 1861)

23. Hindfemora bicolored or entirely rufous ..... *(piscatrix* Lacordaire, 1845)

——Hindfemora uniformly metallic 24

24. Form rather broad; head distinctly narrowed behind eyes, which are slightly smaller than in *subtilis,* but appear to be

more protruding; elytra without transverse, coarse rugae, intervals generally evenly and finely rugose from base-to-apex, laterally mostly with a rather broad, longitudinal, shallow impression; last dorsal abdominal segment emerginate at apex ..... *(distincta)* .. 25

——Form narrower and more elongate; head relatively feebly narrowed behind eyes which are moderately large and moderately prominent; elytra generally with more-or-less distinct transverse, coarse rugae, intervals moderately finely to moderately coarsely rugose from base-to-apex, at apex generally finer and denser, disc occasionally in about basal half or less smooth and shining, at sides and near apex more-or-less densely rugose 26

25. Hindfemur clavate with a moderately large and acute tooth, apical third of elytra depressed ..... *(distincta distincta* Le Conte, 1850)

——Hindfemur less clavate with a very small obscure tooth, apical third of elytra curved ventrad ..... *(distincta occidentalis* Mead, 1938)

26. Elytra shorter, more convex and parallel, when viewed laterad more-or-less distinctly arcuately declivous near apex; prothorax scarcely narrowing behind; median impressed line always distinct; lateral tubercules distinct, though not prominent ..... *(tuberculifrons* Schaeffer, 1919)

——Elytra more elongate, subtriangular, depressed and when viewed laterad flattened above near apex; prothorax distinctly narrowing from base-to-apex; median impressed line rarely present; lateral tubercles feeble and scarcely distinct, or absent ..... *(subtilis)* .. 27

27. Abundant coarse transverse rugae on elytra; antennae slender; hindfemora clavate ..... *(subtilis subtilis* Kunze, 1818)

——Fine and dense strigate-rugose sculpturing on elytra, coarse transverse rugae sparse; antennae stouter; hindfemora less clavate ..... *(subtilis magistrigata* Mead, 1938)

D. Germari Mannerheim 1843. Schaeffer (1925) gives the following record: "Nevada: 'Nev.' (Knab coll.)." The species is nationwide, and in other localities has been recorded from *Caltha palustris* (marsh marigold).

D. Pusilla Pyritosa Le Conte 1857. Again from Schaeffer (1925): "Nevada: 'Nev.' (Minn. Univ.)." The typical subspecies has been recorded from rushes, *Carex stricta* (sedge), and spiked maple.

D. Hirticollis Kirby 1837. Schaeffer records this from "California: Lake Tahoe (Mann.)" Since the lake lies in both California and Nevada, the species is certain to be found in the latter state. Recorded hosts are *Nuphar polysepalum* and *Potamogeton* spp.

The adjacent Californian *D. piscatrix* inhabits the flowers of *Nuphar* spp., the yellow waterlily. *D. pubescens* is known from "California: Lake Co. (Van Dyke)" (Schaeffer 1925), and seems

to be a northern form. It has been found on pickerel weed, and is the only North American species with pubescent elytra. *D. distincta occidentalis* was described from California, as was *D. subtilis magistrigata;* the typical subspecies of the latter has been found on *Sparganium* and goldenrod. *D. tuberculifrons* is known from Utah and points east and is recorded from yellow pondlily, bulrushes *(Scirpus* spp.) and *Sparganium. D. emarginata* occurs east of Nevada, one of the nearest localities being Utah's Great Salt Lake (Van Duzee specimens). *D. emarginata pacifica* Schaeffer 1925 was described from the California Sierras with no host data. *D. dubia* is known from Idaho, while *D. vermiculata* was described from California, and may perhaps be only an aberrant *D. longicollis.*

The only available key to larvae (MacGillivray 1903) includes but three of the above-listed species, and is appended for the aid it may offer in evaluating larval characters:

1. Supraspiracular setae of the first five abdominal segments extending caudad as far as the caudal margin of the posterior setae ..... *(emarginata)*
——Supraspiracular setae of the first four abdominal segments not extending caudad as far as the front margin of the posterior tergal band of setae 2
2. Sternal setae of the fifth abdominal segment divided longitudinally by a mesal line into two groups; the posterior sternal setae of the midthorax undivided ..... *(cincticornis)*
——Sternal setae of the fifth abdominal segment not divided; the posterior sternal setae of the mesothorax not divided longitudinally into two groups ..... *(subtilis)*

The general lifehistory details below are from MacGillivray's work in New York (1903):

The species of *Donacia* exhibited certain differences in egglaying, some laying their eggs on plant stems, others on the underside of floating leaves and others along the edge of leaf sheaths. Eggs hatched in about 10 days, and "the young larvae find their way to the bottom of the pond and among the ooze and attach themselves to the underground stems of the yellow pondlily. Numerous underground stems of the white pondlily were examined, and not a single one was found with the larvae of Donacia attached to it, or with any indications of where larvae had been feeding on it, though in most cases the stems of the two species of plants were intertwined.

"When the large underground stems were examined, they were usually found covered with larvae of various sizes and with cocoons. The larvae were found clinging to the larger roots and feeding on

the fine rootlets with which the roots are covered. Several roots" . . . . "appeared to be covered with minute tubercles. These tubercles are the places from which the rootlets have been cut off by the larvae. In addition to the above, the larvae also eat holes in the apices of the larger roots."

MacGillivray was the first investigator to intelligibly solve the problems of respiration in these larvae, who seem to have no structural modifications adapting them to an underwater life.

Speaking of the tissues of underwater plants—"Each of these spaces is filled with air, and it is on such a supply that the larvae and pupae of Donacia depend. The larvae tap the air supply locked up in the stems of aquatic plants by pushing their caudal spines through the epidermis of the plant and rupturing the cells surrounding the air spaces. The air contained by such plants is of about the same richness in oxygen as the surrounding atmosphere. When the tissue of the plant is ruptured, the inclosed air, being lighter than the water, moves to the outer surface of the plant, and, if there were nothing to collect it, it would pass on to the surface of the water. But the spiracular openings being at the immediate base of the spines and the larva holding the apex of its abdomen close to the surface of the plant, the air is collected before it can escape into the water.

"In order to explain how the larva of Donacia obtains its supply of air from the intercellular spaces of plants, I do not think it is necessary to assume any extraordinary structures for the caudal spines. The caudal spines are nothing more than projections of the body wall for rupturing the tissues of the plant; and, when this is accomplished, the air, being so much lighter than the surrounding water and having a strong tendency to follow along anything that will carry it to a higher level, simply follows along the outer surface of the caudal spines to their base, where it is taken up by the spiracles, while the two large longitudinal trachea connecting with the spines take up the supply of air and act as resevoirs for storing it between the air-taking periods.

"When the larvae are ready to transform to pupae, they spin a tough, brownish cocoon, which is attached to the scars on the upper surface of the rhizome from which the leaf stalks have been shed. The silk is spun from glands opening into the mouth. The cocoons are not only water-tight but air-tight and are of a homogeneous consistency throughout without any indication of a thread-like structure. The bottom of the cocoon where it is attached to the plant is much

thinner and lighter in color and is firmly glued to the surface of the plant."

The larva apparently excludes water from the inside of the cocoon by "surrounding itself while spinning its cocoon by a quantity of air sufficient to fill the vacant space in the cocoon . . . The large excavation" (referring to the slit made by the larva in the stem of the plant) "is always near the center of the cocoon and is undoubtedly made by the larva before transforming to a pupa. In this way the larva provides a continuous air supply for itself by tapping the store held in the intercellular air spaces of the plant. Since some individuals of Donacia live for 10 months or more in the cocoon, need for a copius and continuous air supply becomes apparent.

"The pupa transforms to a beetle long before it is time for it to emerge. When it is ready to emerge, the end of the cocoon is broken off and the beetle crawls out. The ventral surface of most of the species of Donacia is densely covered with fine silken hairs, so that, when the beetle emerges from its cocoon, the air contained in the cocoon at this time is held to the ventral surface of the beetle by these silken hairs and in this way provides an air supply for it till it reaches the surface of the water. This silken cover is also of use to those species that lay eggs under water."

(Haemonia Latreille, 1829)

H. *nigricornis* Kirby 1837 seems the only species known in the United States, and is quite variable as attested by its synonymicon. Blatchley (1910) records it from pondweed *(Potamogeton)*, on which it also occurs in Europe, being known there from the roots of the plant.

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